

**Brake Pad Partnership Project**

**Copper Use Monitoring Program  
Results for Model Years 1998 - 2001**

**February 11, 2003**

For more information, please contact: Sarah Connick, Facilitator  
Brake Pad Partnership Project  
Sustainable Conservation  
121 Second Street, 6<sup>th</sup> Floor  
San Francisco, CA 94105  
415/977-0380, x314  
[sconnick@suscon.org](mailto:sconnick@suscon.org)

## **Introduction and Purpose**

This report contains data on copper use in original equipment<sup>1</sup> automotive friction materials<sup>2</sup> for the 1998, 1999, 2000, and model years, which are presented in Table 1. “Friction materials” include disc brake pads (on front and rear brakes) and drum brake linings (on rear brakes only). The Brake Manufacturers Council’s Product Environmental Committee (BMC/PEC) reports annually on the amount of copper in friction materials as a part of its members’ participation in the Brake Pad Partnership.<sup>3,4</sup>

These data are important to the Brake Pad Partnership for the purposes of:

- (1) monitoring trends in copper use over the course of the Partnership, and monitoring the industry’s voluntary reduction in use of copper in the event the Partnership determines that copper from friction materials is a significant cause of water quality impairment; and
- (2) providing inputs for modeling studies of the environmental fate and transport of automotive friction material wear debris in the environment.

## **Data Strengths and Limitations**

- **Best available data set.** These are the most comprehensive and reliable data available regarding the copper content of automotive friction materials in the United States. They are reported voluntarily by the BMC/PEC as a part of its members’ participation in the Brake Pad Partnership, and would not be collected and made publicly available without the Partnership’s cooperative approach.
- **Data are for 40% of new automobiles.** The data are reported for the copper content of vehicle friction materials for the top 20 best selling vehicles, which comprise approximately 40% of the new cars and light trucks sold in the United States.<sup>5</sup>

---

<sup>1</sup> “Original equipment” refers to equipment that comes on new vehicles, and does not include “aftermarket” or replacement parts.

<sup>2</sup> “Automotive friction materials” refers to friction materials used in cars and light trucks, and does not include friction materials used on heavy-duty trucks, off-road vehicles, or motorcycles.

<sup>3</sup> The Brake Pad Partnership is a collaborative effort to understand the impacts on the environment that may arise from brake pad wear debris generated in the use of passenger vehicles. Working together, manufacturers, regulators, stormwater management agencies, and environmentalists are developing an approach for evaluating potential impacts on water quality, using copper in the South San Francisco Bay as an example. Friction material manufacturers have committed to adding this evaluation approach to their existing practices for designing products that are safe for the environment while still meeting the performance requirements demanded of these important safety-related products.

<sup>4</sup> The data reported herein were originally reported in: Lawrence, Jim. “Friction Material Content Monitoring: A Project of the BMC Product Environmental Committee. Motor and Equipment Manufacturers Association, Research Triangle Park, North Carolina. September 9, 2002.

<sup>5</sup> The top 20 sample comprised 42.8% of the new domestic cars and light trucks sold in the United States for model year 1998, 41.0% for model year 1999, 39.3% for model year 2000, and 39.7% for model year 2001. The source for this information is *Ward’s Automotive Yearbooks* (see footnote 9).

**TABLE 1. Friction Material Copper Content Monitoring Results<sup>4</sup>**

Model Year:	<u>1998</u>	<u>1999</u>	<u>2000<sup>6</sup></u>	<u>2001</u>
<b><u>Top 20 Sample<sup>7</sup></u></b>				
<b>Total vehicle sales (vehicles)</b>	15,540,765	16,890,536	17,349,760	17,122,368
<b>Top 20 vehicle sales (vehicles)</b>	6,659,538	6,931,931	6,810,814	6,799,008
<b>% of total vehicle sales</b>	42.8%	41.0%	39.3%	39.7%
<b>Friction material in Top 20 (kg)</b>	9,366,940	9,109,322	8,556,864	8,416,727
<b>Friction material per vehicle (kg)</b>	1.406	1.314	1.256	1.238
<b>Cu in Top 20 (kg)</b>	267,462	358,541	384,145	381,507
<b>Cu per vehicle (kg)</b>	0.0402	0.0517	0.0564	0.0561
<b><u>Random 20 Sample<sup>8</sup></u></b>				
<b>Friction material per vehicle (kg)</b>	--	--	0.9460	
<b>Cu per vehicle (kg)</b>	--	--	0.0542	

- **Trend indicator.** The data indicate the industry trend in use of copper in friction materials. The data do not provide the total amount of copper used in friction materials in the vehicle fleet.
- **Data are not designed for mass load calculations.** These data are not intended nor are they appropriate for calculating total copper loadings to the environment from friction materials on a national, regional, or local scale. While the data represent a significant sample of new vehicles, they encompass less than half of the friction materials in new vehicles. Copper use in other vehicles and vehicle sectors, and in the aftermarket is likely to differ significantly from that reported here for the top 20 new vehicles. Within a region or watershed, variations in fleet mix and vehicle use patterns also contribute to differences in copper content and amounts of wear debris released to the environment. It is important to note that not all of the copper in friction materials is released to the environment. Friction material ingredients can wear out of a pad or lining at different rates, and brake pads and linings are normally replaced with a considerable amount of the friction material still intact.

<sup>6</sup> Note, the data reported here for model year 2000 differ slightly from those reported previously. The application of new quality assurance and quality control procedures detected a small misreporting of the total number of model year 2000 vehicles sold, which led to a correction of the numbers shown here.

<sup>7</sup> A list of the Top 20 vehicles for each model year is included in Table 2.

<sup>8</sup> A list of the Random 20 vehicles for model year 2000 is included in Table 3. Random 20 sample data were not collected for model years 1998 and 1999.

- **Actual copper content.** The data are based on manufacturers' reporting of the actual copper content of their products. These data are collected and made available by the BMC/PEC in a manner that protects manufacturers' confidential business information, including the copper content of friction materials on specific new vehicles and the name of the manufacturer that supplies the friction materials.
- **Actual vehicle sales data.** The data reflect actual sales for each model year.
- **Vehicle fleet mixes vary.** The data do not reflect regional variations in vehicle fleet mixes. The difference between the copper content reported for the top 20 sample in comparison to the random 20 sample illustrates the variability in the copper content of friction materials in different vehicle fleet mixes.
- **Aftermarket (replacement) brake pads and linings are not included.** The data are for "original equipment" friction materials only. "Original equipment" refers to parts that are installed on new vehicles. It does not include "aftermarket" or replacement parts. The BMC/PEC has stated that the copper content of aftermarket friction materials is small, but no public data are available to confirm that statement.
- **Heavy-duty trucks, off-road vehicles, and motorcycles are not included.** These data are for friction materials used in cars and light trucks. The data do not include friction materials used on heavy-duty trucks, off-road vehicles, or motorcycles. Manufacturers of these other friction material types are not currently participating in the Brake Pad Partnership.

### **Data Collection and Reporting Process**

The Brake Manufacturers Council's Product Environmental Committee (BMC/PEC) consists of the majority of companies that manufacture original equipment friction materials for automotive vehicles manufactured in the United States, Canada, and Mexico for sale in the United States. The BMC/PEC has developed a process for collecting and reporting these data that produces accurate information while maintaining the confidentiality of its member companies' proprietary business information.

The data reported here represent the amount of copper and friction material used on the top 20 most popular vehicles sold in the United States, by model year, which comprises approximately 40% of the total U.S. sales of domestic automobiles. Copper use data are also reported for a random selection of 20 model year 2000 vehicles, which comprised 8.4% of the total sales for that year.

### **Sample Selection**

The sample selected for data collection was the top 20 best selling domestic cars and light trucks for each model year. Data on actual vehicle sales were obtained from the *Ward's*

*Automotive Yearbooks*.<sup>9</sup> The list of the Top 20 vehicles for model years 1998 through 2001 and their sales volumes are shown in Table 2.

In addition, a random sample of 20 vehicles was selected for model year 2000 to provide some insight on how representative the Top 20 sample is of the total domestic vehicle sales in regard to copper use. First, all vehicles with annual sales of more than 20,000 units were identified based on sales information provided in *Ward's Automotive Yearbooks*. The vehicles were listed in the same order as they appear in *Ward's*—*i.e.*, by segment (*e.g.*, small car, van, large pickup, etc.)<sup>10</sup>—and then by manufacturer and model within each segment. Next, starting with the first vehicle on the list, every eleventh vehicle was selected generating a list of more than 30 vehicles. Then all vehicles that also appeared on the Top 20 list were eliminated. The result of this process was the list of Random 20 vehicles that appears in Table 3. Table 3 also includes information on the sales volumes for the Top 20 and Random 20 samples for the year 2000 for comparison purposes.

### **Data Collection**

Each year, data are requested from each of the BMC/PEC member companies on the friction materials supplied for each of the vehicle makes and models on the Top 20 list. Specifically, information is requested for the make and model to which the manufacturers supplied in January of the model year. For model year 2000, data were also requested for the vehicles on the Random 20 list.

A copy of the information request form used is contained in Appendix B. The specific information requested of and reported by the manufacturers included:

- the weight of the friction material for one axle set (front and rear reported separately),
- the total copper by weight in the friction material for one axle set, and
- the percentage of the model production for which the data are applicable.

### **Data Aggregation**

The BMC/PEC process for collecting and reporting these data is designed to maintain the confidentiality of its member companies' proprietary business information. Thus, upon receipt of the reporting information from the member companies, the data were recorded and the original information destroyed.

The resultant aggregated data, combined with the actual annual sales volume numbers from *Ward's Automotive Reports*, contains information on the total friction material and copper use for the Top 20 sample for each model year, and for the Random 20 sample for model year 2000. These data are reported in Table 1.

Data for two models in the Random 20 sample for model year 2000 were unavailable because the models were not supplied by BMC/PEC companies. Thus, the data for these two models are not included in the reporting for the Random 20 sample.

<sup>9</sup> 1999 Ward's Automotive Yearbook, 61<sup>st</sup> Edition. Ward's Communications, Detroit. Pp. 246-248.

2000 Ward's Automotive Yearbook, 62<sup>nd</sup> Edition. Ward's Communications, Detroit. Pp. 244-246.

2001 Ward's Automotive Yearbook, 63<sup>rd</sup> Edition. Ward's Communications, Detroit. Pp. 249-251.

2002 Ward's Automotive Yearbook, 64<sup>th</sup> Edition. Ward's Communications, Detroit. Pp. 243-245.

<sup>10</sup> Appendix A contains definitions of the vehicle segments used by *Ward's Automotive Yearbook*.

**TABLE 2. Top 20 Vehicles and Actual Sales for Model Years 1998 through 2001.<sup>9</sup>**

<u>Segment, Make and Model<sup>0</sup></u>	<u>Actual Sales</u>			
	1998	1999	2000	2001
<b><i>Small Car</i></b>	<b>5.1%</b>	<b>4.6%</b>	<b>7.1%</b>	<b>7.1%</b>
Chevrolet Cavalier	256,099	272,122	236,803	233,298
Ford Escort	291,936	260,486	--	--
Ford Focus	--	--	286,166	264,414
Saturn	--	--	177,355	162,110
Toyota Corolla	250,500	249,128	230,156	245,023
Honda Civic	--	--	306,748	311,314
<b>Segment total</b>	<b>798,535</b>	<b>781,736</b>	<b>1,237,228</b>	<b>1,216,159</b>
<b><i>Middle Car</i></b>	<b>11.3%</b>	<b>10.5%</b>	<b>8.2%</b>	<b>9.2%</b>
Chevrolet Malibu	223,703	218,540	207,376	176,583
Honda Civic	317,134	308,807	--	--
Pontiac Grand Am/Oldsmobile Alero <sup>11</sup>	180,428	234,936	214,923	291,348
Ford Taurus/Mercury Sable <sup>12</sup>	371,074	368,327	382,035	456,206
Honda Accord	370,984	316,339	317,483	350,090
Toyota Camry	295,108	320,156	298,123	303,436
<b>Segment total</b>	<b>1,758,431</b>	<b>1,767,105</b>	<b>1,419,940</b>	<b>1,577,663</b>
<b><i>Sport Utility Vehicle (SUV)</i></b>	<b>7.4%</b>	<b>7.4%</b>	<b>7.3%</b>	<b>5.2%</b>
Chevrolet Blazer	219,710	232,140	255,948	--
Ford Explorer/Mercury Mountaineer	479,083	478,003	491,704	461,495
Jeep Grand Cherokee	229,135	300,031	271,723	223,612
Ford Expedition/Lincoln Navigator	225,703	233,125	251,406	209,804
<b>Segment total</b>	<b>1,153,631</b>	<b>1,243,299</b>	<b>1,270,781</b>	<b>894,911</b>
<b><i>Van/Small Pickup</i></b>	<b>6.8%</b>	<b>6.3%</b>	<b>5.6%</b>	<b>5.8%</b>
Dodge Caravan/Plymouth Voyager/Chrysler Voyager	450,790	431,744	384,561	287,481
GMC Sonoma/S10	282,912	291,661	262,680	204,243
Ford Ranger/Mazda <sup>13</sup>	328,136	348,358	330,125	298,591
Ford Windstar/Mercury Voyager	--	--	--	201,641
<b>Segment total</b>	<b>1,061,838</b>	<b>1,071,763</b>	<b>977,366</b>	<b>991,956</b>
<b><i>Large Pickup</i></b>	<b>12.1%</b>	<b>12.2%</b>	<b>11.2%</b>	<b>12.4%</b>
Chevrolet Silverado/GMC Sierra	235,110	734,234	734,377	908,629
Chevrolet and GMC C/K	454,311	98,285	--	--
Dodge Ram	410,130	428,930	380,874	344,538
Ford F-series	787,552	806,579	820,248	865,152
<b>Segment total</b>	<b>1,887,103</b>	<b>2,068,028</b>	<b>1,935,499</b>	<b>2,118,319</b>
<b>Total Top 20 vehicle sales</b>	<b>6,659,538</b>	<b>6,931,931</b>	<b>6,810,814</b>	<b>6,799,008</b>
<b>Percent of total vehicle sales</b>	<b>42.8%</b>	<b>41.0%</b>	<b>39.3%</b>	<b>39.7%</b>
<b>Total vehicle sales</b>	<b>15,540,765</b>	<b>16,890,536</b>	<b>17,349,760</b>	<b>17,122,368</b>

<sup>11</sup> Starting 2001 includes Oldsmobile Alero.<sup>12</sup> Starting 2001 includes Mercury Sable.<sup>13</sup> Starting 2001 includes Mazda.

**TABLE 3. Top 20 and Random 20 Vehicles and Actual Sales for Model Year 2000.**<sup>14</sup>

Vehicle Segment <sup>9</sup>	<u>Top 20 Sample</u>		<u>Random 20 Sample</u>	
	Make and Model	Actual Sales	Make and Model	Actual Sales
<i>Small Car</i>		<b>7.1%</b>		<b>1.32%</b>
	Chevrolet Cavalier	236,803	Dodge Neon	113,381
	Ford Focus	286,166	Mazda Protégé	62,851
	Saturn	177,355	Chevrolet Prizm	52,116
	Toyota Corolla	230,156		
	Honda Civic	306,748		
	<b>Segment total</b>	<b>1,237,228</b>		<b>228,348</b>
<i>Middle Car</i>		<b>8.2%</b>		<b>1.05%</b>
	Chevrolet Malibu	207,376	Nissan Maxima	-- <sup>15</sup>
	Pontiac Grand Am	214,923	Oldsmobile Intrigue	64,109
	Ford Taurus	382,035	Mazda 626	71,046
	Honda Accord	317,483	Chevrolet Lumina	46,573
	Toyota Camry	298,123		
	<b>Segment total</b>	<b>1,419,940</b>		<b>181,728</b>
<i>Luxury/Large Car</i>		<b>0%</b>		<b>1.63%</b>
			Ford Crown Victoria	92,047
			Chrysler Concorde	50,206
			Lincoln LS	51,039
			Buick Park Avenue	47,669
			Lexus ES300	41,320
	<b>Segment total</b>	<b>0</b>		<b>282,281</b>
<i>Sport Utility Vehicle (SUV)</i>		<b>7.3%</b>		<b>1.97%</b>
	Chevrolet Blazer	255,948	Jeep Cherokee	141,457
	Ford Explorer/Mercury Mountaineer	491,704	Toyota 4Runner	111,797
	Jeep Grand Cherokee	271,723	Nissan Xterra	88,578
	Ford Expedition/Lincoln Navigator	251,406		
	<b>Segment total</b>	<b>1,270,781</b>		<b>341,832</b>
<i>Van/Small Pickup</i>		<b>5.6%</b>		<b>1.89%</b>
	Dodge Caravan/Plymouth Voyager/Chrysler Voyager	384,561	Nissan Frontier	-- <sup>11</sup>
	GMC Sonoma/S10	262,680	Toyota Sienna	103,137
	Ford Ranger	330,125	Chevrolet Venture	97,450
			Honda Odyssey	126,686
	<b>Segment total</b>	<b>977,366</b>		<b>327,273</b>
<i>Large Pickup</i>		<b>11.1%</b>		<b>0.58%</b>
	Chevrolet Silverado/GMC Sierra	734,587	Toyota Tundra	100,445
	Dodge Ram	380,874		
	Ford F-series	819,686		
	<b>Segment total</b>	<b>1,935,147</b>		<b>100,445</b>
	<b>Total vehicle sales for each sample</b>	<b>6,840,462</b>		<b>1,461,907</b>
	<i>Percent of total vehicle sales</i>	<b>39.4%</b>		<b>8.4%</b>

<sup>14</sup> 2001 Ward's Automotive Yearbook, 63<sup>rd</sup> Edition. Ward's Communications, Detroit. Pp. 249-251.<sup>15</sup> Model year 2000 copper content data are not available for the Nissan Maxima and Frontier.

## APPENDIX A

### Vehicle Segment Definitions Used in *Ward's Automotive Yearbook*

<u>Segment</u>	<u>Typical Price range</u>	<u>Typical Length</u>
<b><u>Small Cars</u></b>		
Lower Small Car	\$11,500 and under	Under 175 inches
Upper Small Car	\$11,501 to \$17,999	Under 180 inches
Small Specialty Car	Under \$18,000	Under 180 inches
<b><u>Middle Cars</u></b>		
Lower Middle Car	\$14,500 to \$18,499	180 to 190 inches
Upper Middle Car	\$18,500 to \$24,999	180 to 190 inches
Middle Specialty Car	\$14,500 to \$24,900	180 to 199 inches
<b><u>Large Cars</u></b>		
Large Car	Under \$25,000	Over 200 inches
<b><u>Luxury Cars</u></b>		
Lower Luxury Car	\$25,000 to \$32,999	-
Middle Luxury Car	\$33,000 to \$43,999	-
Upper Luxury Car	\$44,000 plus	-
Luxury Specialty Car	\$25,000 plus	-
Luxury Sport Car	\$25,000 plus	-
<b><u>Sport Utility Vehicles (SUV)</u></b>		
Small SUV	Under \$20,000	Under 170 inches
Middle SUV	Under \$30,000	170 to 192 inches
Middle Luxury SUV	\$30,000 plus	170 to 192 inches
Large SUV	Under \$40,000	Over 192 inches
Large Luxury SUV	\$40,000 plus	Over 192 inches
<b><u>Vans</u></b>		
Small Van	Under \$26,000	Under 210 inches
Large Van	Under \$26,000	210 inches plus
Luxury Van	\$26,000 plus	-
<b><u>Pickup Trucks</u></b>		
Small Pickups	\$14,000 and under	Under 200 inches
Large Pickups	Above \$14,000	200 inches plus



APPENDIX B

Sample Information Request Form

**Product Environmental Committee  
Friction Material Monitoring**

**CONFIDENTIAL**

*This information is for the exclusive  
use of the Brake Manufacturers Council*

- Directions:
1. Mark the model year(s) applicable to the data.
  2. List the make and model. (Example: Ford Ranger)
  3. Report the axle set weights in grams.  
Friction material weight is without steel, etc.  
Copper content is for the axle set [*see instructions*].
  4. Please fill in all blanks (use NA for "not applicable").
  5. Return by fax, mail, or e-mail.

**Model year (s):** 00 01

**Make & Model:** \_\_\_\_\_

**Front axle:** *Friction* \_\_\_\_\_ grams *Copper* \_\_\_\_\_ grams {note 1}

*Percentage of model* \_\_\_\_\_ **Example: May be different materials  
with or without ABS**

**Rear axle:** *Friction* \_\_\_\_\_ grams *Copper* \_\_\_\_\_ grams {note 1}

*Percentage of model* \_\_\_\_\_

**Note 1.** The copper level in storm water is determined by atomic adsorption on unfiltered storm water. The water sample is treated with nitric acid to digest all forms of copper.

Factors for calculating net copper content in various copper containing additives are:

- Brass: Typical copper content is 70.0 wt%, but may vary with the type of brass.
- Copper oxide (Cu<sub>2</sub>O): 88.8 wt% copper
- Copper oxide (CuO): 79.9 wt% copper
- Copper sulfide (Cu<sub>2</sub>S): 79.9 wt% copper
- Copper sulfide (CuS): 66.5 wt% copper

**Report the net %**  
**(NOTE: Same process as used for  
1998 and 1999 Model Years)**

**Return to: Brake Council Project Administrator**  
10 Laboratory Drive  
Research Triangle Park, NC 27709-3966

**Fax: 919-406-1306**

**E-mail: pbecoat@mema.org**